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ON THE ABUNDANCE AND ECOLOGY OF RICINULEI (ARACHNIDA) FROM CENTRAL AMAZONIA, BRAZIL

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Abstract.—Ricinuleids from primary and secondary dryland forest soils in the region of Manaus represented two species: (1) *Cryptocellus becki* with 94 specimens, mostly juveniles, maximum abundance 38 ind./m^2, and predominantly obtained during the dry season and (2) *Cryptocellus adisi* with 17 specimens, mostly juveniles, up to 10 ind./m^2, and more frequent during the dry season. These sympatric species appear to be separated in their mutual habitat by spatial differences, with *C. becki* inhabiting mostly the organic soil layer and the smaller *C. adisi* the mineral subsoil. *C. becki* showed no distinct reproductive period and its first stage of development occurred throughout the year.

Neotropical ricinuleids are litter and soil inhabitants of dryland forests in Central Amazonia (Morais, 1985; Rodrigues, 1986). They have not been found in caves (Karmann, 1986; Adis, unpubl.) or in inundation forests along rivers in the Amazon Basin (Adis, 1981).

A comparison of the abundance and ecology of *Cryptocellus becki* Platnick and Shadab (1977) and *C. adisi* Platnick (1988) from primary and secondary dryland forest sites in the region of Manaus is now possible, as the taxonomic evaluation has been completed.

STUDY AREA AND METHODS

Ricinuleids were collected between 1982 and 1983 in the course of ecological studies on Central Amazonian arthropods from two previously investigated and fully described forest types, all within 30 km of Manaus: (1) in a primary dryland forest (terra firme forest) at Reserva Florestal A. Ducke (2°55′S, 59°59′W) on the Manaus-Itacoatiara highway (AM-010 at km 26), study area of Adis and Schubart (1984), Adis et al. (1984), Morais (1985), Penny and Arias (1982) and others; (2) in a cut but unburned secondary dryland forest (capoeira forest) adjacent to an inundation forest at Rio Tarumã Mirím (03°02′S, 60°17′W), a tributary of the Rio Negro, study area of Adis and Schubart (1984) and Rodrigues (1986). Both forest types were subject to a rainy season (December–May: average precipitation 1,550 mm) and a dry season (June–November: average precipitation 550 mm; cf. Ribeiro and Adis, 1984).

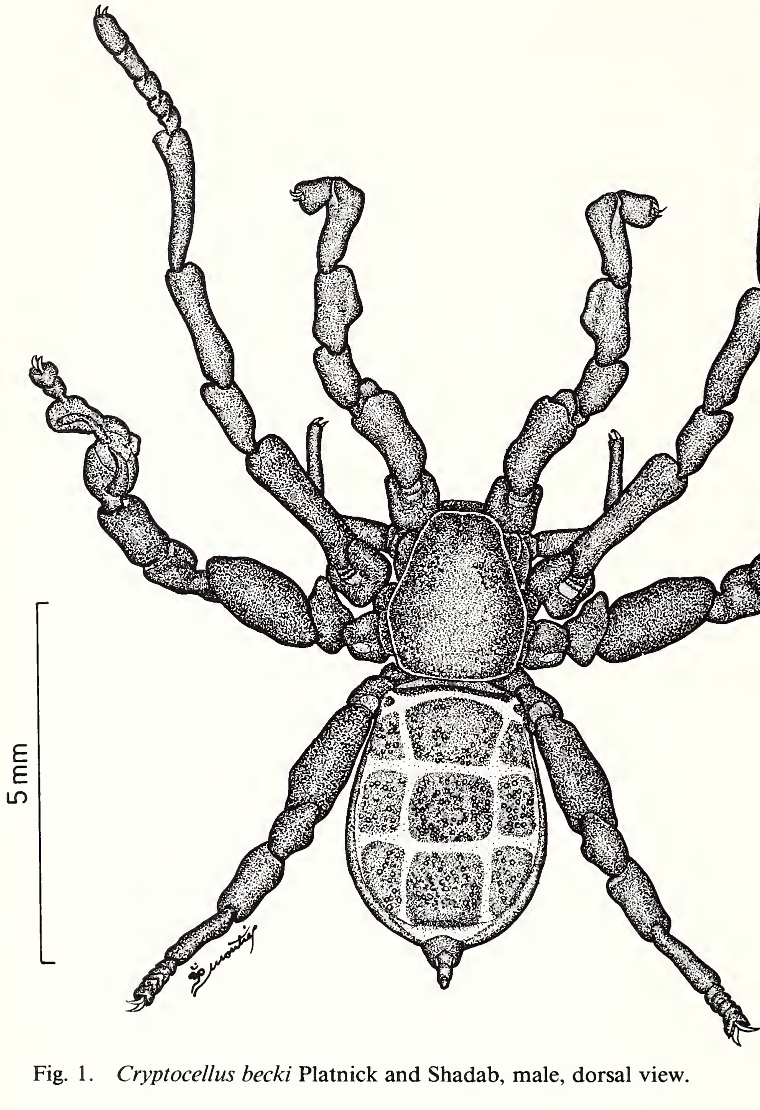

Fig. 1. *Cryptocellus becki* Platnick and Shadab, male, dorsal view.

The yellow latosoil of the primary and secondary forest supported a 2–3 cm thick humus layer (A_o), interspersed with fine roots, and a thin, surface covering leaf litter. Morais (1985) and Rodrigues (1986) provided data on the presence of ricinuleids in the soil between August, 1982 and August, 1983. Once a month they took twelve soil samples (in each forest) along a transect, selected at random, with a split corer (a steel cylinder with lateral hinges, diameter 21 cm, length 33 cm), which was driven into the soil by a mallet. Each sample of 7 cm depth was then divided into two subsamples of 3.5 cm each. Animals were extracted from subsamples following a modified method of Kempson (Adis, 1987).

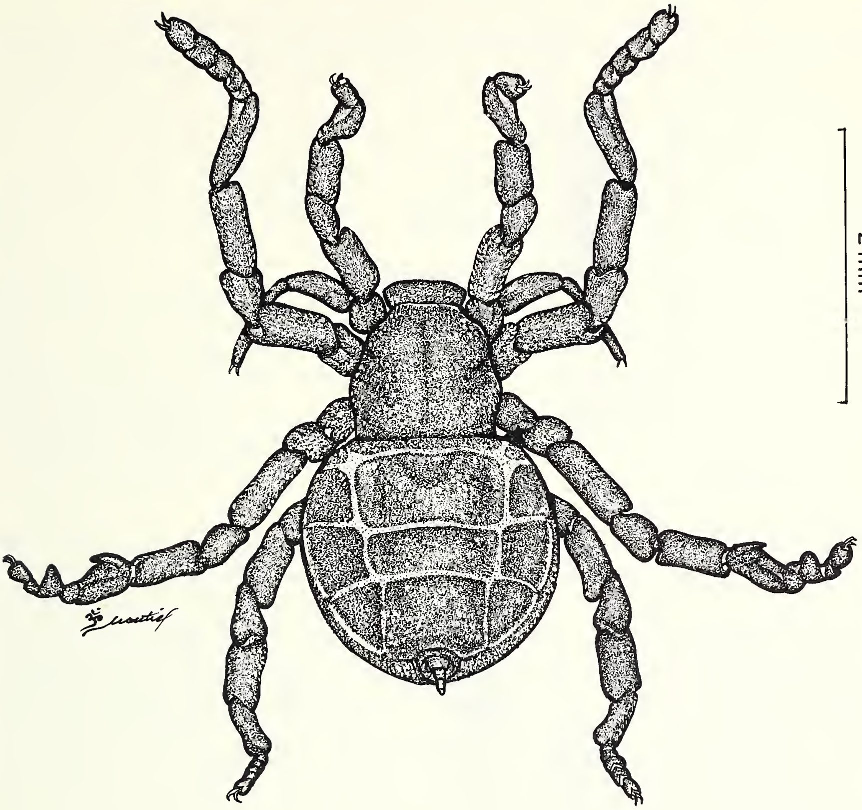

Fig. 2. *Cryptocellus adisi* Platnick, male, dorsal view.

Additional ricinuleids were obtained in a cut but unburned secondary dryland forest at the campus of INPA, Manaus (03°08′S, 60°01′W), study area of Prance (1975). One sampling each was carried out during the dry season in September, 1985 and during the rainy season in April, 1986 (Adis et al., 1987a, b). Six soil samples were taken, respectively, to a depth of 14 cm, divided into four subsamples of 3.5 cm each, and animals extracted as described above.

All ricinuleids collected were identified to species and classified as juveniles (larvae, protonymphs, deutonymphs, tritonymphs) or adults (males and females), according to the number of legs and tarsal segments per stage (Mitchell, 1970; Pittard and Mitchell, 1972). A correlation between the population density and weather conditions of *C. becki* in the secondary dryland forest was statistically investigated with the linear correlation-test (Cavalli-Sforza, 1972), using the original field data.

RESULTS AND DISCUSSION

In total, 111 ricinuleids have been evaluated. *Cryptocellus becki* (Fig. 1) represented 85% of the total catch. About 79% of all ricinuleids came from the secondary forest

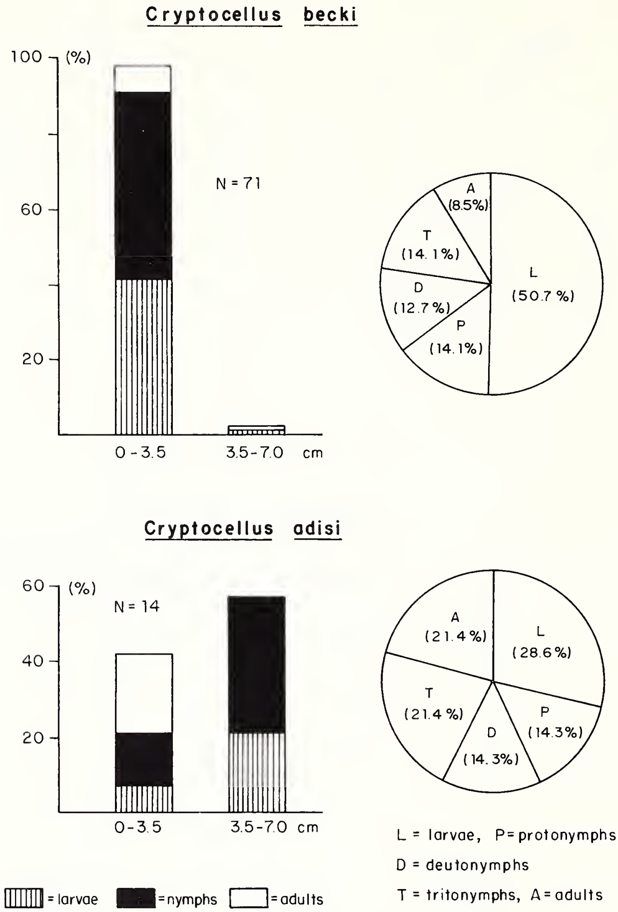

Fig. 3. Distribution of *Cryptocellus becki* and *Cryptocellus adisi* in the soil according to soil depth, and percentage of all developmental stages in the secondary dryland forest at Rio Tarumã Mirím near Manaus. (Total catch = 100% for each species.) Samples taken monthly at 0–3.5 and 3.5–7 cm depths between August, 1982 and August, 1983. N = total number of specimens.

at Rio Tarumã Mirím, where abundance was highest, with 36 ind./m^2 for the larger species *C. becki* and 10 ind./m^2 for the smaller *C. adisi* (Table 1). In the primary forest abundance was lower with 7 ind./m^2 for *C. becki* and 5 ind./m^2 for *C. adisi.* In both forest types ricinuleids represented fewer than 0.1% of all arthropods extracted from the soil during 13 months (Morais, 1985; Rodrigues, 1986). In the secondary forest at INPA, only *C. becki* was collected with 10 ind./m^2 during the dry season and 38 ind./m^2 during the rainy season (Adis et al., 1987 a, b).

In the primary and secondary forests under study, ricinuleids were only found in the soil and never caught in traps on tree trunks (Adis and Schubart, unpubl.). No specimens were caught in emergence traps on the forest floor (see Penny and Arias,

Table 1. Length of carapace and total length of *Cryptocellus becki* and *Cryptocellus adisi* according to developmental stages from primary and secondary dryland forests in the region of Manaus. Measurements (in mm) taken for all specimens caught per species (*C. becki* = 94; *C. adisi* = 17).

Stage of development	*C. becki* Length of carapace	*C. becki* Total length*	*C. adisi* Length of carapace	*C. adisi* Total length*
Larvae	0.60–0.72	1.38–2.10	0.60–0.66	1.44–1.50
Protonymph	0.78–1.02	2.22–2.94	0.72[c]	1.56–1.68
Deutonymph	1.08–1.26	3.06–4.32	0.84–0.90	1.98–2.52
Tritonymph	(1.02)[b] 1.32–1.68	(2.82)[b] 4.44–5.22	1.02	2.64–3.00
Male	(2.05)[b] 2.34–2.40	5.42–6.00	1.08–1.14	3.15–3.30
Female	1.80–(1.84)[a]	5.28[c]	1.11–1.26	3.16–3.54

* Excluding pygidium.
[a] Literature data from the same habitat (Platnick and Shadab, 1977).
[b] Exceptional small specimens (cf. Fig. 4).
[c] Only one specimen sampled.

1982; Adis, unpubl.), indicating that *C. becki* and *C. adisi* are not active on the soil surface. This conclusion is supported by another study in the primary forest, in which no ricinuleids were collected from 20 baited pitfall traps (see Penny and Arias, 1982).

In all forests under study, most specimens of *C. becki* inhabited the organic layer (cf. Fig. 3: 0–3.5 cm), and a few the mineral subsoil. Almost 92% of all *C. becki* specimens obtained in the secondary forest at Rio Tarumã Mirím were juveniles, with more than half representing the first instar, i.e., larvae (Fig. 3). Almost two thirds of these were collected during the rainy season (December–May). No adults were obtained during the dry season. *C. adisi* from the same habitat was mostly collected during the dry season (71% of the total catch; N = 50). Adults were only obtained from the organic layer (Fig. 3) and 73% of the juveniles inhabited the mineral subsoil (3.5–7 cm depth). The two sympatric *Cryptocellus* species appear to be separated in their habitat by spatial and probably temporal differences. The smaller size of *C. adisi* (Table 1) certainly favors euedaphic life, i.e., inhabitation of lower soil layers, which was also reported for Palpigradi from the same forest (Rodrigues, 1986) and for Pseudoscorpiones and Symphyla from inundation forests (Adis and Mahnert, 1985; Adis and Scheller, 1984).

Soil arthropods of dryland forests were shown to have no distinct reproductive period (Adis et al., 1988; Adis and Sturm, 1987). This also holds for ricinuleids, at least for *C. becki,* as larvae were found throughout the year (Fig. 4). Measurements based on carapace size are justified, as increase of the somewhat varying body length per developmental stage is correlated with the more constant carapace length (Fig. 5), with exceptions in the size of some female tritonymphs disregarded (cf. Fig. 4). Distinct correlations between the population densities of *C. becki* and weather conditions in the secondary forest at Rio Tarumã Mirím (see Rodrigues, 1986) could not be found. Only the larvae were somewhat more abundant during lower maximum temperatures of the air near the forest floor ($P < 0.05$; $r > 0.5703$, N = 13).

No observations were made on the food spectrum of *C. becki* and *C. adisi* (cf. Cooke, 1967; Mitchell, 1970). An unexpected enemy of Central Amazonian ricinu-

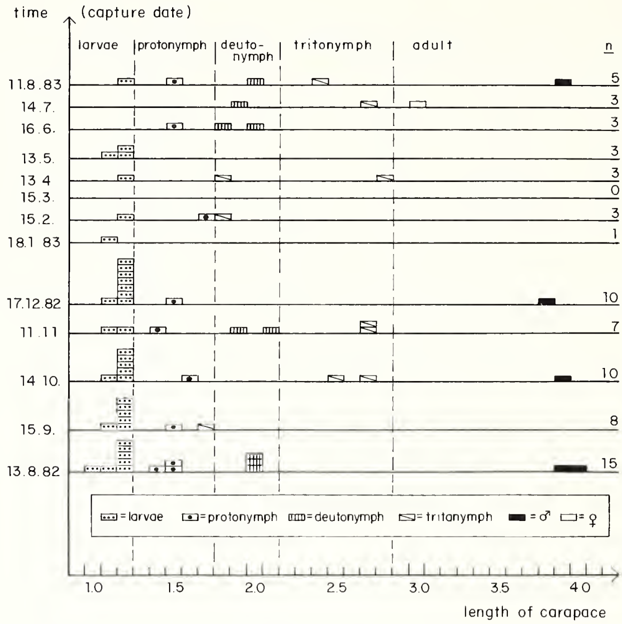

Fig. 4. Developmental stages of *Cryptocellus becki* extracted from soil samples of a secondary dryland forest at Rio Tarumã Mirím near Manaus. Data arranged by length of carapace (1 gradation = 0.6 mm) and capture date. Samples taken monthly at 0–7 cm depth between August, 1982 and August, 1983. N = total number of specimens caught per month.

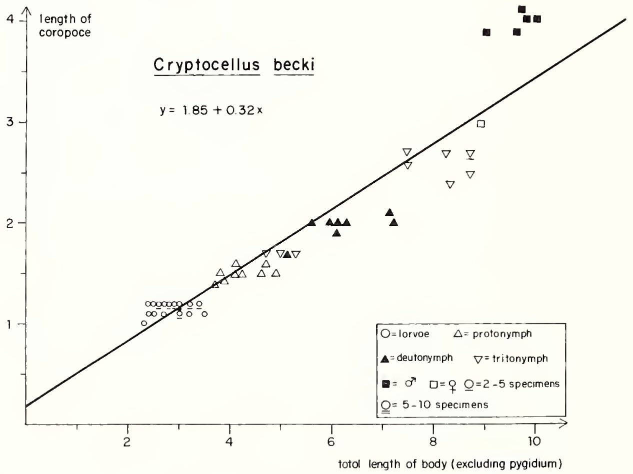

Fig. 5. Relation between length of carapace and total length of body during post-embryonic growth of *Cryptocellus becki* (1 gradation = 0.6 mm). Seventy-one specimens extracted from soil samples taken monthly at 0–7 cm depth between August, 1982 and August, 1983 in a secondary dryland forest at Rio Tarumã Mirím near Manaus (cf. Fig. 4).

leids is *Peripatus* sp. (Onychophora). One was observed which covered a male of *C. becki* with filaments from its mucus glands, killing the ricinuleids within a few hours.

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